CHEMICALS

Project Fact Sheet

Affinity Ceramic Membranes with CO_2 Transport Channels

Benefits

- Potentially significant energy savings due to increased separation efficiency
- Lower capital and operating costs compared to absorbent-based separations
- Maintains thermal, hydrothermal and chemical stability after surface modifications are made to the membrane

Applications

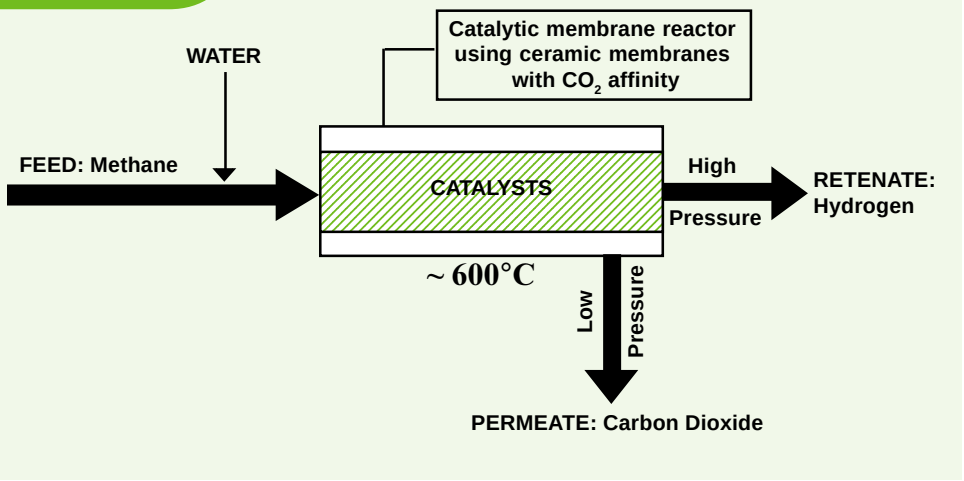
Many existing and emerging applications can benefit from the use of the CO_2 affinity inorganic membrane. The most promising applications are the removal of CO_2 in natural gas processing, landfill gas recovery, power generation and hydrogen production.

Thermally and Hydrothermally Stable Affinity Ceramic Membranes Increase Energy Efficiency

Membrane separation processes have several advantages over distillation separation, including increased energy efficiency, compact design, and operational flexibility. Numerous unexploited applications exist for advanced membrane separations that rely on the membrane's affinity to a specific chemical as opposed to traditional molecular sieving. To perform these affinity separations, modifications must be made to the membrane's surface. Inorganic membranes, which are used in niche applications involving high temperatures and harsh environments, are currently unable to retain the features required for the niche application after surface modification. To address this challenge, project partners are developing a new inorganic affinity membrane that retains its surface properties in a wide range of industrial, harsh environment separations.

To prepare the inorganic affinity membrane, project partners are incorporating proprietary ceramic material into commercially available porous ceramic membrane modules. This material has shown a strong specific affinity for carbon dioxide (CO_2). Since the separation is based upon its affinity to CO_2, the permeate side of the membrane can be purged with a wide range of gases, such as air or steam, which are economically and readily available in the chemical processing industry. In addition, the proposed membrane is expected to be hydrothermally stable for many industrial applications.

Affinity Membrane



Methane steam reforming using an affinity membrane in a catalytic membrane reactor.

Project Description

Goal: The goal of this project is to develop an inorganic membrane that can demonstrate separations based upon affinity while still maintaining its material stability in harsh environments.

This membrane will be formed with a unique type of inorganic material with a specific affinity for CO_2. The affinity membrane will be supported on commercially available porous ceramic substrates. The benefit of the developed affinity membranes will be demonstrated in a pilot-scale methane stream reforming application.

Progress and Milestones

Early-stage research results demonstrated enhanced CO_2 transport provided by the proposed membrane, as well as the intrinsic thermal/hydrothermal stability of the selected ceramic material.

Current research is focused on achieving the following milestones:

- Optimize the membrane synthesis based upon the simplified protocol developed in initial stage research
- Conduct a comprehensive functional performance evaluation, including enhanced CO_2 transport as a function of temperature and pressure, as well as the membrane's hydrothermal stability
- Demonstrate long-term operational stability under a simulated application environment
- Establish a database for inorganic material composition versus functional performance
- Perform economic analysis on selected technology applications

Commercialization

Media and Process Technology Inc. (M&P), a ceramic membrane manufacturer, will market the unique affinity ceramic membrane as part of its commercial product line. In addition, M&P is pursuing partnerships with end-users and process developers to develop and commercialize unique and proprietary applications using this product.

Project Partners

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